US009863083B2

(12) **United States Patent**
Leibman et al.

(10) **Patent No.: US 9,863,083 B2**
(45) **Date of Patent: Jan. 9, 2018**

(54) **DISPENSING SYSTEM UTILIZING MASS FLOW OF WATER**

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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 453 days.

(21) Appl. No.: **14/461,586**

(22) Filed: **Aug. 18, 2014**

(65) **Prior Publication Data**

US 2016/0047078 A1 Feb. 18, 2016

(51) **Int. Cl.**
D06F 39/02 (2006.01)
D06F 23/04 (2006.01)

(52) **U.S. Cl.**
CPC ***D06F 39/028*** (2013.01); *D06F 23/04* (2013.01); *D06F 39/022* (2013.01)

(58) **Field of Classification Search**
CPC D06F 39/028; D06F 23/04; D06F 39/022
See application file for complete search history.

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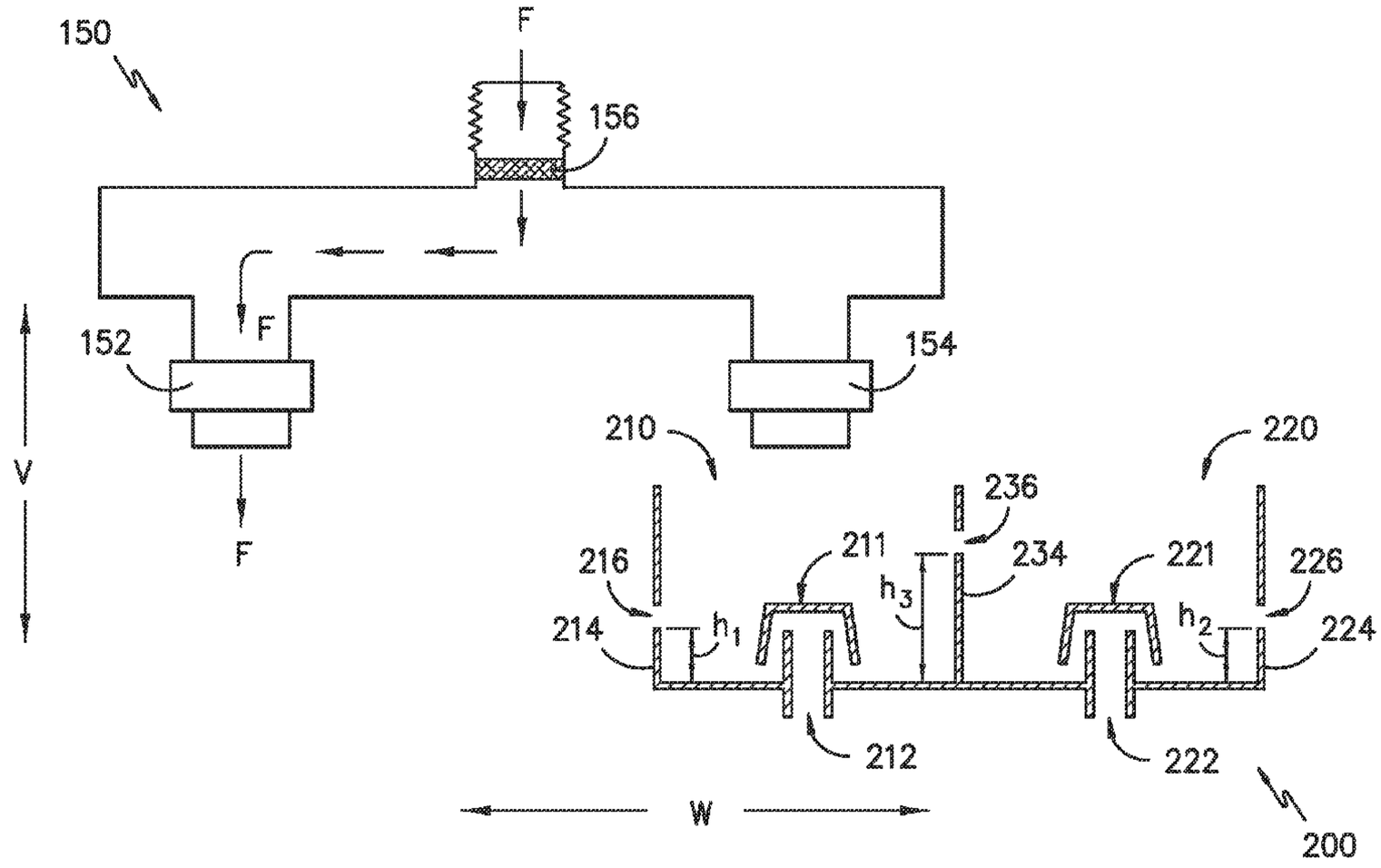
(57) **ABSTRACT**

A washing machine appliance and a method for operating a washing machine appliance are provided. The washing machine appliance includes one or more features for dispensing fluid additives using fewer valves. The method includes one or more steps for dispensing fluid additives using fewer valves.

11 Claims, 7 Drawing Sheets



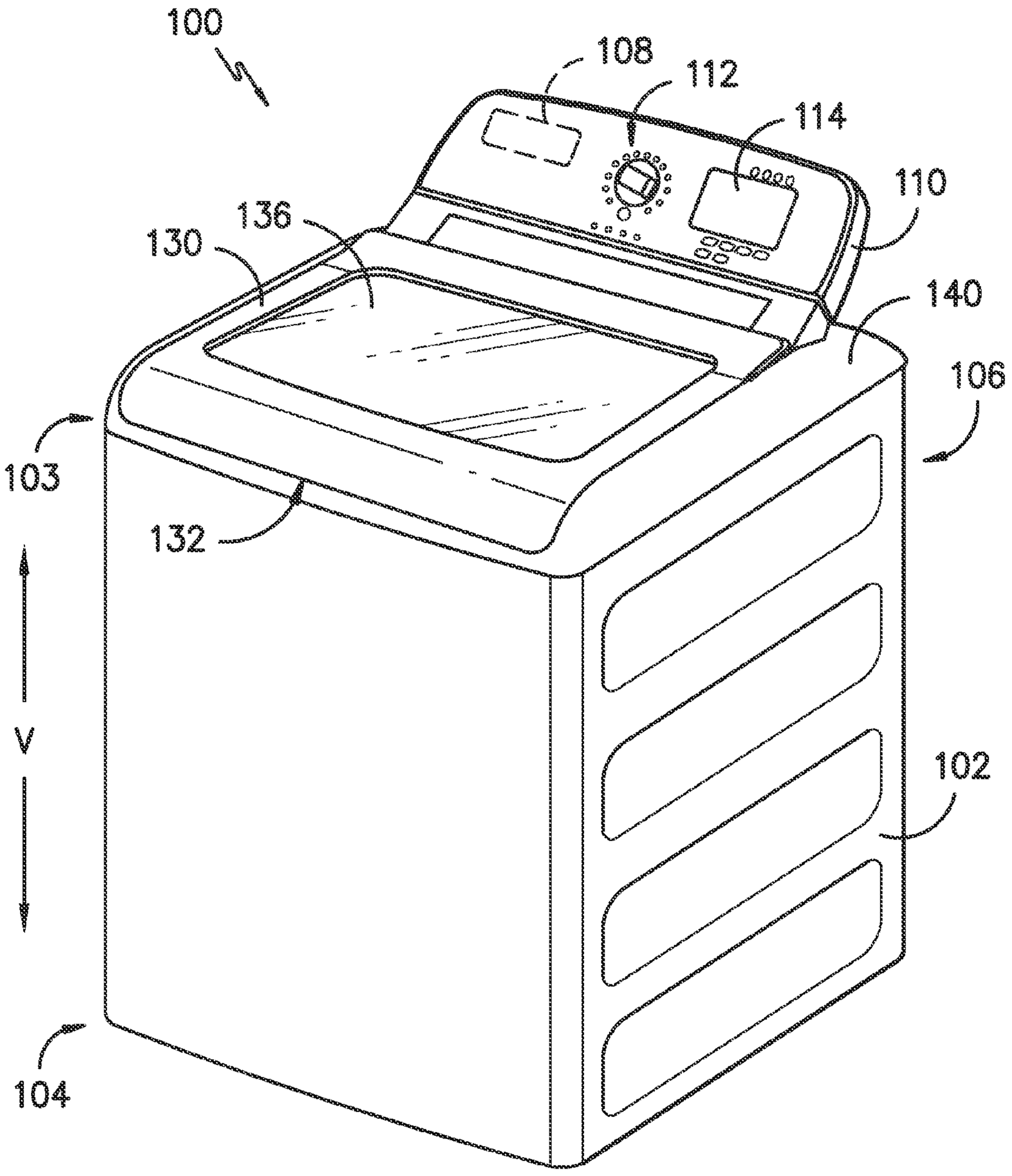


FIG. –1–

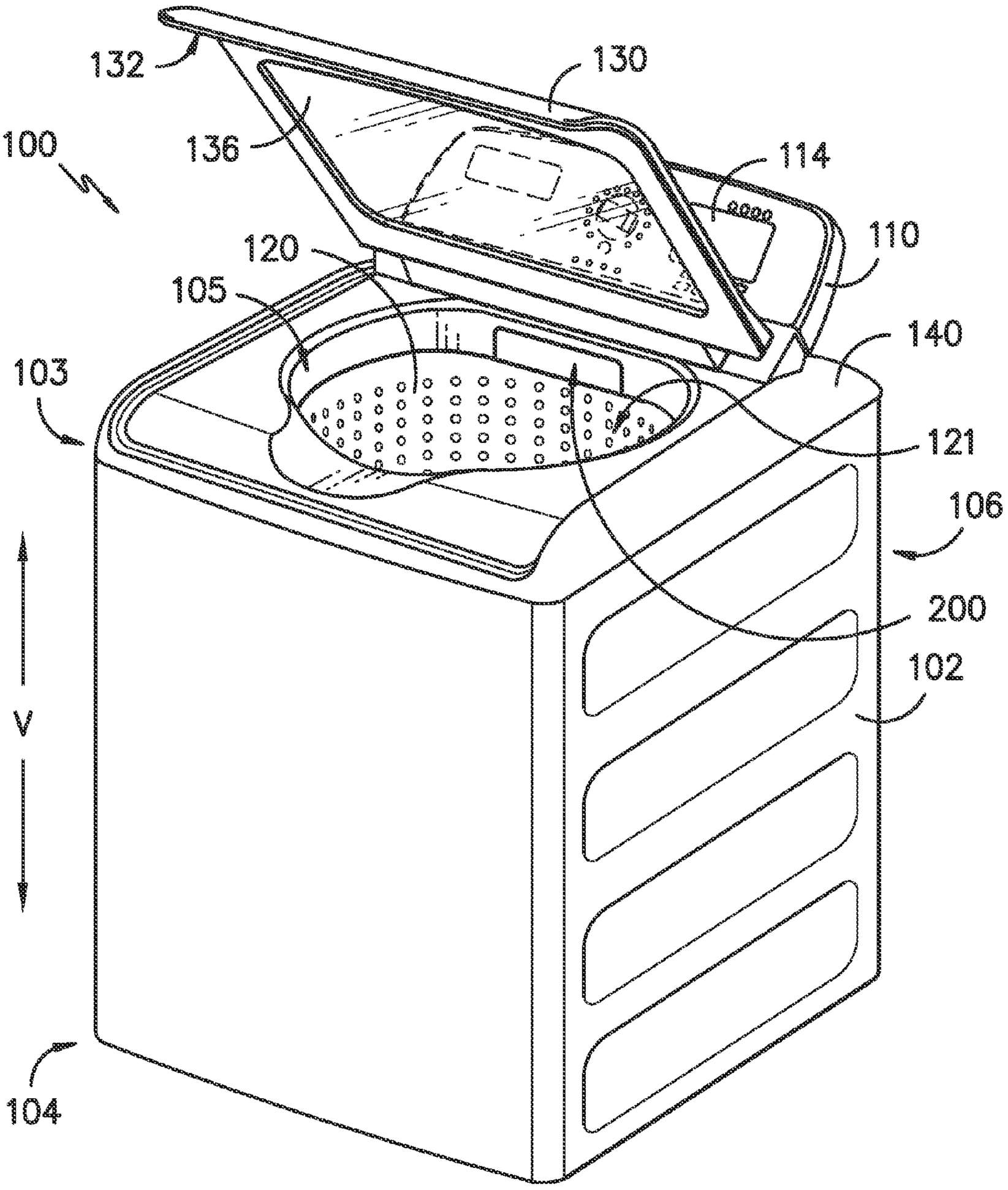


FIG. –2–

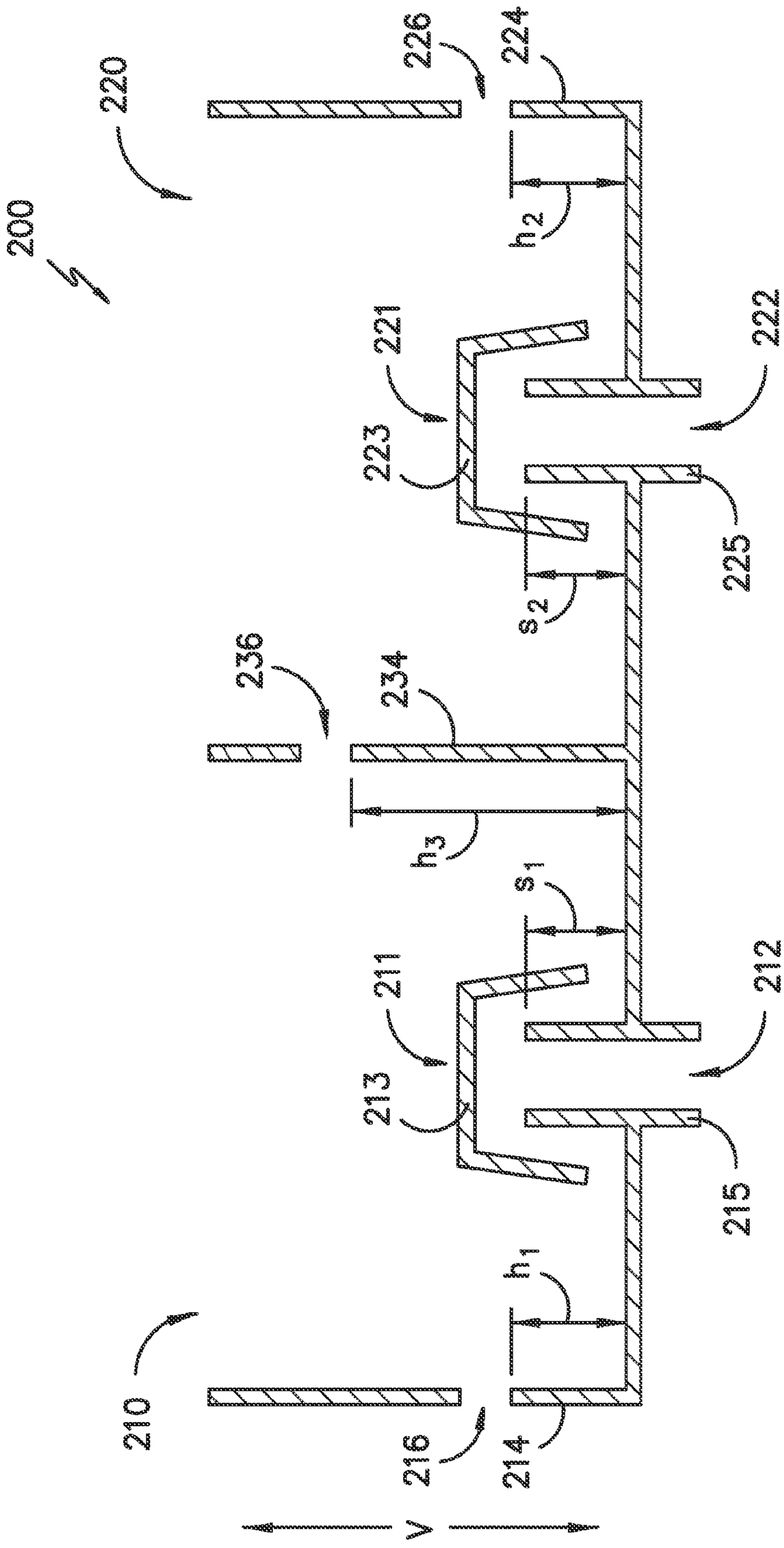

200
210
211
212
213
214
215
216
220
221
222
223
224
225
226
234
236
h1
h2
h3
s1
s2
W
Y

FIG. 3

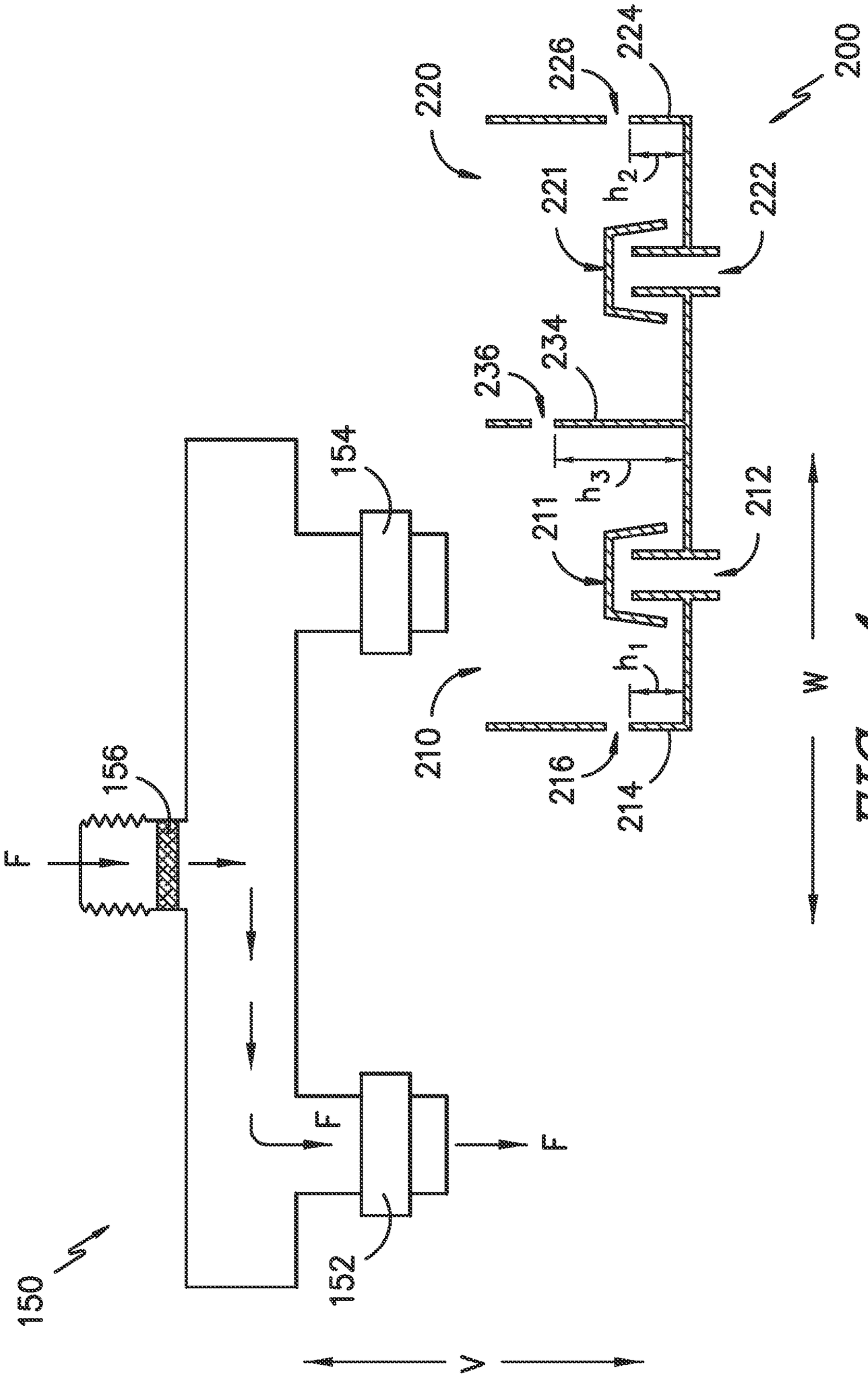

150
152
154
156
210
211
212
214
216
220
221
222
224
226
234
236
200
E
E
E
W
Y
h_1
h_2
h_3

FIG. -4-

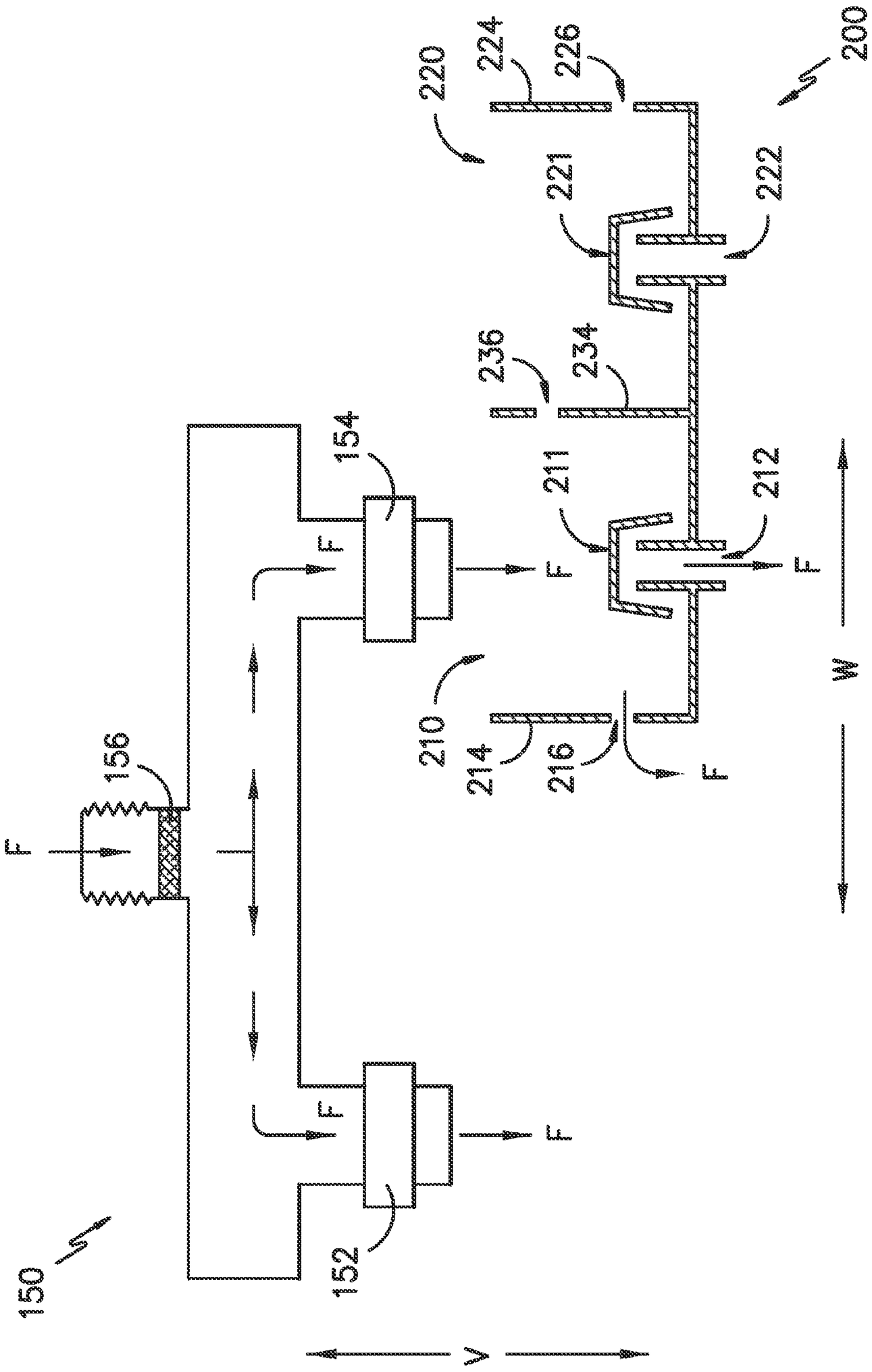

150
152
154
156
200
210
211
212
214
216
220
221
222
224
226
234
236
E
E
E
E
E
E
W
Y

FIG. -5-

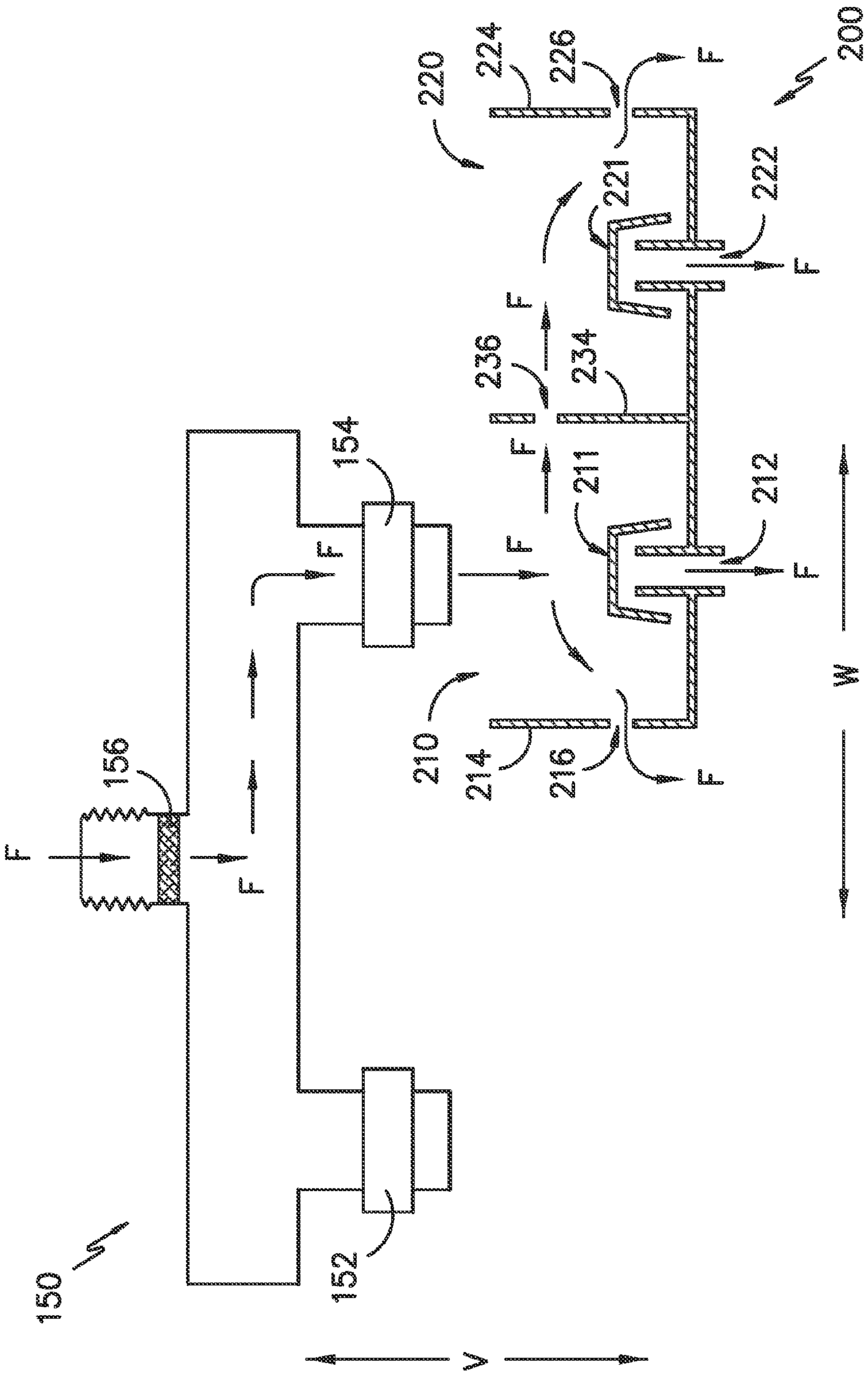

150
152
154
156
200
210
211
212
214
216
220
221
222
224
226
234
236
F
W
Y

FIG. -6-

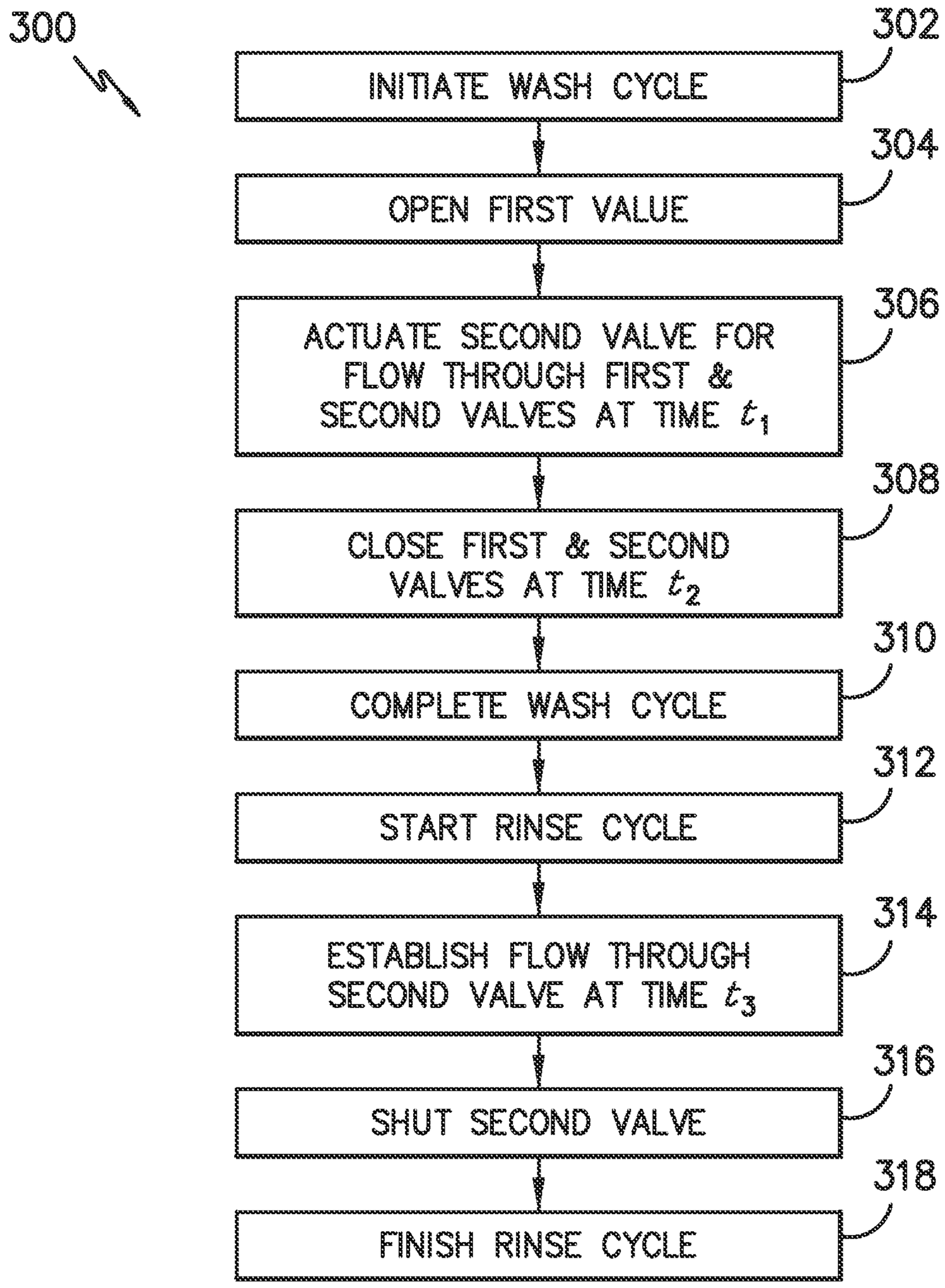

300
302
INITIATE WASH CYCLE
304
OPEN FIRST VALUE
306
ACTUATE SECOND VALVE FOR FLOW THROUGH FIRST & SECOND VALVES AT TIME t_1
308
CLOSE FIRST & SECOND VALVES AT TIME t_2
310
COMPLETE WASH CYCLE
312
START RINSE CYCLE
314
ESTABLISH FLOW THROUGH SECOND VALVE AT TIME t_3
316
SHUT SECOND VALVE
318
FINISH RINSE CYCLE

FIG. –7–

DISPENSING SYSTEM UTILIZING MASS FLOW OF WATER

FIELD OF THE INVENTION

The subject matter of the present disclosure relates generally to washing machine appliances and methods of operating washing machine appliances.

BACKGROUND OF THE INVENTION

Washing machine appliances generally form wash and rinse fluids to clean clothing articles disposed within a wash basket of the appliance. The wash and rinse fluids can be formed in a wash tub of a washing machine appliance and can include water and various fluid additives such as, e.g., detergent, fabric softener, and/or bleach. To introduce one or more fluid additives into the wash tub, a user can manually add the fluid additive to the wash tub and/or the wash basket. For example, after starting the appliance, the user can pour detergent directly into the wash basket. Conversely, certain washing machine appliances include features for receiving fluid additives and dispensing the fluid additives during operation of the appliance. For example, a washing machine appliance can include one or more compartments that receive fluid additives and direct the fluid additives into the wash tub.

The fluid additive contained in a compartment is flushed from the compartment into the wash tub of the appliance through an influx of water into the compartment. Usually, each fluid additive is directed to the wash tub at a different point in the cleaning cycle, requiring a valve for each compartment to dispense fluid additives to the wash tub. For washing machine appliances having multiple compartments for receiving fluid additives, the cost and complexity of such appliances is increased because multiple water valves are required.

Accordingly, a washing machine appliance having fewer valves for dispensing fluid additives to the wash tub of the washing machine appliance would be useful. More particularly, a washing machine appliance having a one water valve to provide water to more than one fluid additive compartment would be beneficial. In addition, a method for operating a washing machine appliance to dispense fluid additives to a wash tub of the washing machine appliance using fewer valves would be advantageous.

BRIEF DESCRIPTION OF THE INVENTION

The present subject matter provides a washing machine appliance and a method for operating a washing machine appliance. The washing machine appliance includes one or more features for dispensing fluid additives using fewer valves. The method includes one or more steps for dispensing fluid additives using fewer valves. Additional aspects and advantages of the invention will be set forth in part in the following description, or may be apparent from the description, or may be learned through practice of the invention.

In a first exemplary embodiment, a washing machine appliance is provided. The washing machine appliance defines a vertical direction and includes a cabinet; a wash tub located within the cabinet; a wash basket rotatably mounted within the wash tub; and a fluid additive dispenser. The fluid additive dispenser includes a first compartment configured for receipt of a fluid additive. The first compartment has a first outlet and a first opening to provide fluid to the wash basket. The fluid additive dispenser also includes a second compartment configured for receipt of a fluid additive; the second compartment has a second outlet and a second opening to provide fluid to the wash basket. Further, the fluid additive dispenser includes a third opening; the third opening allows fluid communication between the first compartment and the second compartment. The washing machine appliance also includes a valve manifold having a first valve configured to provide water to the wash basket and a second valve configured to provide water to the fluid additive dispenser.

In a second exemplary embodiment, a washing machine appliance is provided. The washing machine appliance defines a vertical direction and includes a cabinet; a wash tub located within the cabinet; and a wash basket rotatably mounted within the wash tub. The washing machine appliance also includes a first compartment configured for the receipt of a fluid additive. The first compartment has a first outlet and a first opening to provide fluid to the wash basket. The washing machine appliance further includes a second compartment configured for the receipt of a fluid additive. The second compartment is adjacent the first compartment and has a second outlet and a second opening to provide fluid to the wash basket. The washing machine appliance also includes a third opening defined between the first compartment and the second compartment to allow fluid communication between the first compartment and the second compartment; a first valve configured to provide water to the wash basket; and a second valve configured to provide water to the first and second compartments.

In a third exemplary embodiment, a method for operating a washing machine appliance is provided. The washing machine appliance comprises a first valve for providing water to a wash tub and a second valve for providing water to a first compartment configured to receive a fluid additive, the first compartment having an opening for the flow-through of fluid to a second compartment, the first compartment also having a first outlet, the second compartment having a second outlet. The method comprises the steps of opening the first valve; actuating, at a predetermined time t_1, the second valve to establish a flow of water through both the first valve and the second valve, the flow of water through the second valve to the first compartment sufficient to cause fluid to exit from the first compartment through the outlet; closing the first and second valves at a predetermined time t_2; establishing, at a predetermined time t_3, a flow of water through the second valve, the flow of water through the second valve to the first compartment sufficient to cause fluid to exit from the first compartment through the first outlet, to overflow from the first compartment to the second compartment through the opening, and to exit from the second compartment through the second outlet; and shutting the second valve.

These and other features, aspects and advantages of the present invention will become better understood with reference to the following description and appended claims. The accompanying drawings, which are incorporated in and constitute a part of this specification, illustrate embodiments of the invention and, together with the description, serve to explain the principles of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

A full and enabling disclosure of the present invention, including the best mode thereof, directed to one of ordinary skill in the art, is set forth in the specification, which makes reference to the appended figures.

FIG. **1** illustrates an exemplary embodiment of a washing machine appliance of the present invention with a door shown in a closed position.

FIG. **2** illustrates the exemplary embodiment of a washing machine shown in FIG. **1** except with the door shown in an open position.

FIG. **3** is a cross-sectional view of an exemplary embodiment of a fluid additive dispenser of the present subject matter.

FIG. **4** is a schematic view of a fluid additive dispenser system incorporating the fluid additive dispenser of FIG. **3** within a washing machine appliance, illustrating an exemplary fluid flow path within the system.

FIG. **5** is a schematic view of the fluid additive dispenser system within a washing machine appliance shown in FIG. **4**, illustrating another exemplary fluid flow path within the system.

FIG. **6** is a schematic view of a fluid additive dispenser system within a washing machine appliance shown in FIG. **4**, illustrating another exemplary fluid flow path within the system.

FIG. **7** provides a chart illustrating an exemplary method of operating a washing machine appliance according to the present subject matter.

Use of the same reference numerals in different figures denotes the same or similar features.

DETAILED DESCRIPTION

Reference now will be made in detail to embodiments of the invention, one or more examples of which are illustrated in the drawings. Each example is provided by way of explanation of the invention, not limitation of the invention. In fact, it will be apparent to those skilled in the art that various modifications and variations can be made in the present invention without departing from the scope or spirit of the invention. For instance, features illustrated or described as part of one embodiment can be used with another embodiment to yield a still further embodiment. Thus, it is intended that the present invention covers such modifications and variations as come within the scope of the appended claims and their equivalents.

FIGS. **1** and **2** illustrate an exemplary embodiment of a vertical axis washing machine appliance **100**. In FIG. **1**, a lid or door **130** is shown in a closed position. In FIG. **2**, door **130** is shown in an open position. While described in the context of a specific embodiment of vertical axis washing machine appliance **100**, using the teachings disclosed herein it will be understood that vertical axis washing machine appliance **100** is provided by way of example only. Other washing machine appliances having different configurations, different appearances, and/or different features may also be utilized with the present subject matter as well, e.g., horizontal axis washing machines.

Washing machine appliance **100** has a cabinet **102** that extends between a top **103** and a bottom **104** along a vertical direction V. A wash basket **120** (FIG. **2**) is rotatably mounted within cabinet **102**. A motor (not shown) is in mechanical communication with wash basket **120** to selectively rotate wash basket **120** (e.g., during an agitation or a rinse cycle of washing machine appliance **100**). Wash basket **120** is received within a wash tub or wash chamber **121** (FIG. **2**) and is configured for receipt of articles for washing. The wash tub **121** holds wash and rinse fluids for agitation in wash basket **120** within wash tub **121**. An agitator or impeller (not shown) extends into wash basket **120** and is also in mechanical communication with the motor. The impeller assists agitation of articles disposed within wash basket **120** during operation of washing machine appliance **100**.

Cabinet **102** of washing machine appliance **100** has a top panel **140**. Top panel **140** defines an opening **105** (FIG. **2**) that permits user access to wash basket **120** of wash tub **121**. Door **130**, rotatably mounted to top panel **140**, permits selective access to opening **105**; in particular, door **130** selectively rotates between the closed position shown in FIG. **1** and the open position shown in FIG. **2**. In the closed position, door **130** inhibits access to wash basket **120**. Conversely, in the open position, a user can access wash basket **120**. A window **136** in door **130** permits viewing of wash basket **120** when door **130** is in the closed position, e.g., during operation of washing machine appliance **100**. Door **130** also includes a handle **132** that, e.g., a user may pull and/or lift when opening and closing door **130**. Further, although door **130** is illustrated as mounted to top panel **140**, alternatively, door **130** may be mounted to cabinet **102** or any outer suitable support.

A control panel **110** with at least one input selector **112** (FIG. **1**) extends from top panel **140**. Control panel **110** and input selector **112** collectively form a user interface input for operator selection of machine cycles and features. A display **114** of control panel **110** indicates selected features, operation mode, a countdown timer, and/or other items of interest to appliance users regarding operation.

Operation of washing machine appliance **100** is controlled by a controller or processing device **108** (FIG. **1**) that is operatively coupled to control panel **110** for user manipulation to select washing machine cycles and features. In response to user manipulation of control panel **110**, controller **108** operates the various components of washing machine appliance **100** to execute selected machine cycles and features.

Controller **108** may include a memory and microprocessor, such as a general or special purpose microprocessor operable to execute programming instructions or microcontrol code associated with a cleaning cycle. The memory may represent random access memory such as DRAM, or read only memory such as ROM or FLASH. In one embodiment, the processor executes programming instructions stored in memory. The memory may be a separate component from the processor or may be included onboard within the processor. Alternatively, controller **100** may be constructed without using a microprocessor, e.g., using a combination of discrete analog and/or digital logic circuitry (such as switches, amplifiers, integrators, comparators, flip-flops, AND gates, and the like) to perform control functionality instead of relying upon software. Control panel **110** and other components of washing machine appliance **100** may be in communication with controller **108** via one or more signal lines or shared communication busses.

Top panel **140** includes at least one fluid additive dispenser **200** (FIG. **2**) for receipt of one or more fluid additives, e.g., detergent, fabric softener, and/or bleach. While only one fluid dispenser will be described herein, it will be understood that multiple fluid additive dispensers may be used in alternative embodiments of the invention. Fluid additive dispenser **200** is positioned near wash tub **121**; in FIG. **2**, dispenser **200** is depicted at a vertical position above wash tub **121** near back panel **106** of cabinet **102**, but dispenser **200** could be positioned in other locations as well. Fluid additive dispenser **200** is described in greater detail below.

In an illustrative embodiment, laundry items are loaded into wash basket **120** through opening **105**, and washing

operation is initiated through operator manipulation of input selectors **112**. Wash basket **120** is filled with water and detergent and/or other fluid additives from, e.g., dispenser **200**, to form wash and rinse fluids. As shown in FIGS. **4**, **5**, and **6**, one or more valves can be arranged in a valve manifold **150** and controlled by washing machine appliance **100** to provide for filling wash basket **120** with fluid to the appropriate level for the amount of articles being washed and/or rinsed.

In the illustrated exemplary embodiment of FIGS. **4**, **5**, and **6**, valve manifold **150** includes first valve **152** and second valve **154**. First valve **152** controls the flow of water to wash basket **120**, and second valve **154** controls the flow of water to fluid additive dispenser **200**. In this way, wash basket **120** can be filled with water and/or a mixture of water and fluid additive. Further, a flow limiter **156**, through which the flow rate of water is restricted, is disposed upstream of valves **152**, **154**. By using flow limiter **156**, the flow rate of water supplied to valves **152**, **154** may be regulated such that a known flow rate is supplied to valves **152**, **154**. That is, even if the flow rate of water to valve manifold **150** is unknown, the flow rate of water supplied to valves **152**, **154** from flow limiter **156** may be known. Thus, without knowing the flow rate of water supplied to valve manifold **150**, systems downstream of flow limiter **156**, such as fluid additive dispenser **200**, can be designed based on the known flow rate of water from flow limiter **156**. In alternative embodiments, washing machine appliance **100** may include one or more valves for supplying water to wash basket **120**, fluid additive dispenser **200**, and/or other components without valve manifold **150**.

By way of example for a wash mode, once wash basket **120** is properly filled with fluid, the contents of wash basket **120** can be agitated (e.g., with an impeller as discussed previously) for washing of laundry items in wash basket **120**. After the agitation phase of the wash cycle is completed, wash basket **120** can be drained. Laundry articles can then be rinsed by again adding fluid to wash basket **120** depending on the specifics of the cleaning cycle selected by a user. The impeller may again provide agitation within wash basket **120**. One or more spin cycles also may be used. In particular, a spin cycle may be applied after the wash cycle and/or after the rinse cycle to wring wash fluid from the articles being washed. During a spin cycle, wash basket **120** is rotated at relatively high speeds. After articles disposed in wash basket **120** are cleaned and/or washed, the user can remove the articles from wash basket **120**, e.g., by reaching into wash basket **120** through opening **105**.

While described in the context of a specific embodiment of washing machine appliance **100**, using the teachings disclosed herein it will be understood that washing machine appliance **100** is provided by way of example only. Other washing machine appliances having different configurations (such as horizontal-axis washing machine appliances), different appearances, and/or different features may be utilized with the present subject matter as well.

FIG. **3** illustrates an exemplary embodiment of fluid additive dispenser **200**. As shown, dispenser **200** includes a first compartment **210** and a second compartment **220** for receiving one or more fluid additives defined along a width direction W. In alternative embodiments, fluid additive dispenser **200** may include a different number of compartments, e.g., one, three, or more than three compartments, and/or a different arrangement of compartments for the receipt of one or more fluid additives.

First compartment **210** includes a first wall portion **214** extending along the vertical direction V, and second compartment **220** includes a second wall portion **224** extending along the vertical direction V. First and second compartments **210**, **220** also have a common wall portion **234** extending along vertical direction V. In addition, first compartment **210** includes a first opening **216** defined in first wall portion **214** at a vertical height h_1. Similarly, second compartment **220** includes a second opening **226** defined in second wall portion **224** at a vertical height h_2. A third opening **236** is defined in common wall portion **234** at a vertical height h_3. As shown, third opening **236** is positioned at a vertical distance above first opening **216** and second opening **226**, i.e., h_3 is greater than h_1 and h_2. Height h_1 may be the same as height h_2, or one of height h_1 and h_2 may be greater than the other. In alternative embodiments, first opening **216**, second opening **226**, and third opening **236** may be positioned in other locations.

Further, first compartment **210** includes a first outlet **212**, and second compartment **220** includes a second outlet **222**. First compartment **210** and second compartment **220** are in fluid communication with wash basket **120** through first outlet **212** and second outlet **222** such that a mixture of water and fluid additive may be conveyed from the respective compartment **210**, **220** to wash basket **120**. Moreover, in the illustrated embodiment, first outlet **212** is configured as a siphon **211** and second outlet **222** is configured as siphon **221**, such that, when water is introduced into a respective compartment **210**, **220** and mixes with a fluid additive in the compartment, the mixture of water and fluid additive is siphoned from the compartment through the respective siphon **211**, **221**. Similarly, if water is introduced into a compartment **210**, **220** and a fluid additive is not contained in the compartment, the water may be siphoned through the respective siphon **211**, **221**. As shown, siphon **211** includes a cap **213** and a tube **215**; similarly, siphon **221** includes a cap **223** and a tube **225**. The top of tube **215** is at a vertical height s_1 from the bottom of first compartment **210**, and the top of tube **225** is at a vertical height s_2 from the bottom of second compartment **220**. Height s_1 is less than heights h_1 and h_3, and height s_2 is less than heights h_2 and h_3. Heights s_1, s_2 may be the same, or one of height s_1 and s_2 may be greater than the other. Other configurations of outlets **212**, **222** may be used as well.

FIGS. **4**, **5**, and **6** illustrate how the flow of fluid through a portion of the exemplary embodiment of washing machine **100** may be controlled by valves **152**, **154**. In FIG. **4**, first valve **152** is open and second valve **154** is closed, such that the entire fluid flow through flow limiter **156** exits valve manifold **150** through first valve **152**. That is, the flow rate of fluid through first valve **152** is the same as the flow rate of fluid exiting flow limiter **156**. As an example, if flow limiter **156** limits the flow rate of water from the water supply through valve manifold **150** to about three gallons per minute, when second valve **154** is closed and first valve **152** is open, the flow rate of fluid through first valve **152** is about three gallons per minute. As discussed above, first valve **152** may be a fill valve to control the flow of water to wash basket **120** to fill wash tub **121** for, e.g., wash and rinse cycles of washing machine appliance **100**.

In FIG. **5**, both first valve **152** and second valve **154** are open, such that half of the fluid flow from flow limiter **156** is through first valve **152** and half of the fluid flow from flow limiter **156** is through second valve **154**. That is, the flow rate of fluid through first valve **152** is half the flow rate of fluid exiting flow limiter **156**, and the flow rate of fluid through second valve **154** is half the flow rate of fluid exiting flow limiter **156**. Continuing with the above example, if flow limiter **156** limits the flow rate of water from the water

supply through valve manifold **150** to about three gallons per minute, when both first valve **152** and second valve **154** are open, the flow rate of fluid through first valve **152** is about 1.5 gallons per minute and the flow rate of fluid through second valve **154** is about 1.5 gallons per minute.

As discussed above, second valve **154** may control the flow of water to fluid additive dispenser **200**. In the illustrated exemplary embodiment, the flow of water through second valve **154** flows to first compartment **210**. If first compartment **210** contains a fluid additive, when water flows through second valve **154** to first compartment **210**, a mixture of water and fluid additive is formed in first compartment **210**. The mixture of water and fluid additive exits first compartment **210** through first outlet **212** and first opening **216**. As shown in FIG. **5**, for this example the flow rate of fluid to first compartment **210** is not great enough to cause fluid to flow through third opening **236** to second compartment **220**. That is, flow limiter **156** is sized such that, when both first valve **152** and second valve **154** are open, the flow rate of fluid to first compartment **210** is sufficient to flush any fluid additive that may be contained in first compartment **210** from the compartment through first outlet **212** and first opening **216** but is not great enough for fluid to overflow to second compartment **220** through third opening **236**.

In FIG. **6**, second valve **154** is open and first valve **152** is closed, such that the entire fluid flow through flow limiter **156** exits valve manifold **150** through second valve **154**. That is, the flow rate of fluid through second valve **154** is the same as the flow rate of fluid exiting flow limiter **156**. Continuing with the previous example, if flow limiter **156** limits the flow rate of water from the water supply through valve manifold **150** to about three gallons per minute, when first valve **152** is closed and second valve **154** is open, the flow rate of fluid through second valve **154** is about three gallons per minute.

As illustrated, second valve **154** may control the flow of water to fluid additive dispenser **200** such that the flow of water through second valve **154** flows to first compartment **210**. If any fluid additive is contained in first compartment **210**, a mixture of water and fluid additive exits first compartment **210** through first outlet **212** and first opening **216**. However, unlike in FIG. **5**, when only second valve **154** is open, the flow rate in this example is great enough to cause fluid to flow from first compartment **210** to second compartment **220** through third opening **236**. That is, flow limiter **156** is sized such that the flow provided to first compartment **210** when only second valve **154** is open is at least a minimum flow rate required for a flow of fluid to exit first compartment **210** through first outlet **212** and first opening **216**, as well as overflow to second compartment **220** through third opening **236** and to exit second compartment **220** through second outlet **222** and second opening **226**. Thus, if a fluid additive is contained in second compartment **220**, the fluid overflowing from first compartment **210** may mix with the fluid additive in second compartment **220** and exit second compartment **220** through second outlet **222** and second opening **226**.

Accordingly, instead of using one valve to supply water to each fluid additive compartment, one valve may be used to supply water to multiple fluid additive compartments to flush the fluid additive from the respective compartment and to the wash basket to form wash and/or rinse fluids. In this way, the cost and complexity of including a valve associated with each fluid additive compartment can be avoided.

Moreover, it will be easily understood that, while second valve **154** is described above as positioned such that the flow of fluid from second valve **154** is provided to first compartment **210**, in alternative embodiments, the flow of fluid from second valve **154** could be provided to second compartment **220**. In still other embodiments, washing machine appliance **100** may include more than two fluid additive compartments, and one or more valves may be associated with the multiple fluid additive compartments. Other configurations of valves and fluid additive compartments may be used as well.

FIG. **7** illustrates an exemplary method **300** of operating washing machine appliance **100**. As described above, washing machine appliance **100** may include first valve **152** for providing water to the wash tub **121** and second valve **154** for providing water to first compartment **210**. At step **302** of method **300**, a wash cycle of washing machine appliance **100** is initiated, and at step **304**, first valve **152** is opened, e.g., to fill wash tub **121** to form a wash fluid for washing laundry articles in wash basket **120**. At step **306**, second valve **154** is actuated, at a predetermined time t_1, to establish a flow of water through both first and second valves **152**, **154** such that the flow through second valve **154** is sufficient to flush a fluid additive from first compartment **210** through first outlet **212** and first opening **216** but is not sufficient to overflow first compartment **210** through third opening **236**. That is, if a fluid additive is contained in first compartment **210**, a mixture of water and fluid additive may exit first compartment **210** through first outlet **212** and first opening **216**. If first compartment **210** does not contain a fluid additive, the water entering first compartment **210** from second valve **154** may exit first compartment **210** through first outlet **212** and first opening **216**.

As illustrated at step **308**, first and second valves **152**, **154** are closed at a predetermined time t_2, and the wash cycle is completed at step **310**. In alternative embodiments, second valve **154** may be closed at time t_2 and first valve **152** may be closed after second valve **154** is closed. Thus, predetermined time t_2 may be based on a time sufficient to flush a fluid additive from first compartment **210**, i.e., time t_2 may be selected such that first and second valves **152**, **154** are both open for a sufficient time for a fluid additive to be flushed from first compartment **210** by the flow from second valve **154**.

Next, at step **312**, a rinse cycle of washing machine appliance **100** is started. At a predetermined time t_3, a flow of water is established through second valve **154**, as shown at step **314**. The flow of water through second valve **154** is sufficient to cause fluid to exit from first compartment **210** through first outlet **212** and first opening **216**, to overflow from first compartment **210** to second compartment **220** through third opening **236**, and to exit second compartment **220** through second outlet **222** and second opening **226**. Thus, if first compartment **210** does not contain a fluid additive, when second valve is opened at step **314**, water flows from first compartment **210** through first outlet **212**, first opening **216**, and third opening **236**. The water flowing from first compartment **210** through third opening **236** enters second compartment **220**. If a fluid additive is contained in second compartment **220**, the water forms a mixture with the fluid additive, and the mixture of water and fluid additive may exit second compartment **220** through second outlet **222** and second opening **226**. If a fluid additive is not contained in second compartment **220**, the water entering through third opening **236** may exit second compartment **220** through second outlet **222** and second opening **226**.

Second valve **154** is shut at step **316**, and then at step **318**, the rinse cycle is finished. Second valve **154** may be shut at a predetermined time t_4 that may be based on a sufficient

amount of time after second valve **154** was opened at step **314** to flush any fluid additive contained in second compartment **220** from the compartment. That is, time t_4 may be selected such that only second valve **154** is open for a sufficient time for a fluid additive to be flushed from second compartment **220** by the flow from second valve **154**. Further, in some embodiments, first valve **152** may be opened before or after second valve **154** is shut to provide water to form a rinse fluid. In such embodiments where first valve **152** is opened before second valve **154** is shut, first valve **152** may be opened at or after time t_4, where time t_4 is selected based on a sufficient amount of time to flush any fluid additive contained in second compartment **220** from the compartment when only second valve **154** is open.

Although described for embodiments of washing machine appliance **100** where second valve **154** provides water to first compartment **210**, in alternative embodiments, second valve **154** may be positioned to provide a flow of water to second compartment **220**. In such embodiments, when second valve **154** is actuated at step **306** of method **300**, water flows to second compartment **220** and either water or a mixture of water and fluid additive may exit second compartment **220** through second valve **222** and second opening **226**. Further, for such embodiments, when a flow of water is established through second valve **154** at step **314**, water or a mixture of water and any fluid additive in second compartment **220** may exit second compartment **220** through second outlet **222** and second opening **226**, and fluid may enter first compartment **210** by overflowing second compartment **220** through third opening **236**. If a fluid additive is contained in first compartment **210**, the fluid overflowing from second compartment **220** may mix with the fluid additive, and the mixture may exit first compartment **210** through first outlet **212** and first opening **216**.

Additionally, predetermined times t_1, t_2, t_3, and t_4 may be based on any suitable period of time for dispensing fluid additives to wash basket **120** to form wash and/or rinse fluids. In certain embodiments, at step **302** of method **300**, a device such as, e.g., controller **108** may start counting the time elapsed since the wash cycle was initiated. Then, in such embodiments, second valve **154** may be actuated at step **306** at a predetermined time t_1 from the initiation of the wash cycle; first and second valves **152**, **154** may be closed at step **308** at a predetermined time t_2 from the initiation of the wash cycle, such that t_2 is greater than t_1; at step **314**, a flow of water may be established through second valve **154** at a predetermined time t_3 from the initiation of the wash cycle, such that t_3 is greater than t_2; and at step **316**, second valve **154** may be closed at a predetermined time t_4 from the initiation of the wash cycle, such that t_4 is greater than t_3. In other embodiments, times t_1, t_2, t_3, and t_4 may be measured from other events, e.g., time t_1 may be measured from when first valve **152** is opened at step **304**, time t_2 may be measured from when second valve **154** is actuated at step **306**, time t_3 may be measured from when the rinse cycle is initiated at step **312**, and time t_4 may be measured from when a flow is established through second valve **154** at step **314**. Other ways of measuring times t_1, t_2, t_3, and t_4 may also be used.

Further, other sequences of opening first valve **152** and second valve **154** may be used as well. For example, after a wash cycle is initiated, first valve **152** and second valve **154** may be opened simultaneously, and both valves may remain open for a certain period of time, or until a certain volume of fluid has been dispensed to wash tub **121**. Then, second valve **154** may be closed and first valve **152** may remain open for a certain period of time or until a certain additional volume of fluid has been dispensed to wash tub **121**. Alternatively, first and second valves **152**, **154** may be closed simultaneously. Next, after a rinse cycle has been initiated, second valve **154** may be opened for a certain period of time or until a certain volume of fluid has been dispensed to wash tub **121**. Then, second valve **154** may be closed and first valve **152** may be opened, or first valve **152** may be opened such that both valves are open. In other embodiments, second valve **154** may be closed and both second valve **154** and first valve **152** may remain closed until the method begins again, or until first valve **152** and/or second valve **154** are used according to another method. Other sequences are also possible.

This written description uses examples to disclose the invention, including the best mode, and also to enable any person skilled in the art to practice the invention, including making and using any devices or systems and performing any incorporated methods. The patentable scope of the invention is defined by the claims, and may include other examples that occur to those skilled in the art. Such other examples are intended to be within the scope of the claims if they include structural elements that do not differ from the literal language of the claims, or if they include equivalent structural elements with insubstantial differences from the literal languages of the claims.

What is claimed is:

1. A washing machine appliance defining a vertical direction, the washing machine appliance comprising:

a cabinet;

a wash tub located within the cabinet;

a wash basket rotatably mounted within the wash tub;

a first compartment configured for the receipt of a fluid additive, the first compartment having

a first wall portion extending along the vertical direction from a bottom of the first compartment,

a first opening defined in the first wall portion to provide fluid to the wash basket, and

a first outlet defined in the bottom of the first compartment to provide fluid to the wash basket;

a second compartment configured for the receipt of a fluid additive, the second compartment adjacent the first compartment, the second compartment having

a second wall portion extending along the vertical direction from a bottom of the second compartment,

a second opening defined in the second wall portion to provide fluid to the wash basket, and

a second outlet defined in the bottom of the second compartment to provide fluid to the wash basket;

a third opening defined between the first compartment and the second compartment to allow fluid communication between the first compartment and the second compartment;

a first valve configured to provide water to the wash basket; and

a second valve configured to provide water to the first and second compartments,

wherein the first and second compartments have at least one wall portion extending along the vertical direction that is a common wall portion to both the first and second compartments, and

wherein the third opening is defined in the common wall portion at a vertical distance above both the first and second openings.

2. The washing machine appliance of claim **1**, further comprising a flow limiter disposed upstream of the first and second valves.

3. The washing machine appliance of claim 1, wherein the second valve is positioned to provide water to the first compartment.

4. The washing machine appliance of claim 1, wherein the second valve is positioned to provide water to the second compartment.

5. The washing machine appliance of claim 1, further comprising a fluid additive dispenser and a valve manifold, wherein the fluid additive dispenser comprises the first compartment, the second compartment, and the third opening, and wherein the valve manifold comprises the first valve and the second valve.

6. The washing machine appliance of claim 5, further comprising a flow limiter disposed upstream of the first and second valves.

7. The washing machine appliance of claim 5, wherein the first outlet comprises a siphon.

8. The washing machine appliance of claim 5, wherein the second outlet comprises a siphon.

9. The washing machine appliance of claim 5, wherein the second valve is positioned to provide water to the first compartment of the fluid additive dispenser.

10. The washing machine appliance of claim 5, wherein the second valve is positioned to provide water to the second compartment of the fluid additive dispenser.

11. A washing machine appliance defining a vertical direction, the washing machine appliance comprising:

a cabinet;

a wash tub located within the cabinet;

a wash basket rotatably mounted within the wash tub;

a first compartment configured for the receipt of a fluid additive, the first compartment having

a planar first wall portion extending along the vertical direction from a bottom of the first compartment,

a first opening defined in the first wall portion to provide fluid to the wash basket, the first opening defined at a vertical height h_1 from the bottom of the first compartment, and

a first outlet defined in the bottom of the first compartment to provide fluid to the wash basket;

a second compartment configured for the receipt of a fluid additive, the second compartment adjacent the first compartment, the second compartment having

a planar second wall portion extending along the vertical direction from a bottom of the second compartment,

a second opening defined in the second wall portion to provide fluid to the wash basket, the second opening defined at a vertical height h_2 from the bottom of the second compartment, and

a second outlet defined in the bottom of the second compartment to provide fluid to the wash basket,

a first valve configured to provide water to the wash basket; and

a second valve configured to provide water to the first and second compartments,

wherein the first compartment and the second compartment have a planar common wall portion extending along the vertical direction and defining a third opening to allow fluid communication between the first compartment and the second compartment,

wherein the bottom of the first compartment and the bottom of the second compartment are vertically aligned such that the third opening is defined at a vertical height h_3 from the bottom of each of the first compartment and the second compartment, the vertical height h_3 being greater than the vertical height h_1 and the vertical height h_3 being greater than the vertical height h_2.

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